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FRACTURE OF THE ZYGOMATIC ARCH.

A SIMPLE METHOD OF REDUCTION AND FIXATION, WITH
REMARKS ON THE PREVALENCE, SYMPTOMATOLOGY
AND TREATMENT OF THIS FRACTURE.

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BY RUDOLPH MATAS, M. D., PROFESSOR OF SURGERY, MEDICAL
DEPARTMENT TULANE UNIVERSITY OF LOUISIANA, ETC.

Reprinted from the Sept., 1896, Number of the New Orleans Medical and Surgical Journal.

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An instance of this fracture came under my observation in April, 1895, which I deem worthy of record, not so much on account of the comparative rarity or other interesting peculiarities of this injury, but because it suggested a simple and successful mode of treatment which I feel confident will prove a valuable resource to any surgeon or practitioner who may be called to deal with a similar accident.

As the manner in which the injury was inflicted is unusual, I shall quote the details of the accident as related by the patient himself, who happened to be an esteemed medical friend, Dr. W. S. B. (æt. 34). In a note to me he says: "I was walking rapidly on — street, when, within twenty steps of the corner of the — building, a boy about fourteen or fifteen years of age came rapidly around the corner on a safety. We saw each other, but apparently too late to make any change in our course. He came straight along on the down grade of the sidewalk. I immediately stood still and braced to receive the shock, expecting

* Proceedings Louisiana State Medical Society, May, 1896.



only body blows. His wheel struck my outstretched foot; his checked momentum carried him onward through the air, his wheel overturning at the same time. The prominence of one side of his frontal bone struck the middle of my zygomatic arch. He fell to the ground stunned for a moment, but soon arose, otherwise unhurt, as far as I know. I was stunned momentarily, but did not lose consciousness or fall. The loud report conducted to my ear, and the crushing sensation made by the impact, were nauseating for a few moments. I continued unaided for two blocks to a drug store, then into a cab, and on my way home I was fortunate enough to meet you." * * *

When I met the doctor, a few moments after the accident, he was extremely pale and evidently suffering intensely. A hasty examination revealed a marked depression, or hollow, corresponding to the most prominent portion of the zygomatic arch, about one inch back of the malar prominence. Evidently the arch had been fractured, and the displaced fragment had sunk at least one inch below the level of its malar and temporal processes.

The depression at the broken level easily admitted my thumb at its broadest diameter, and allowed it to sink into the temporal and zygomatic fossæ below the level of the fixed portions of the arch. There was no break in the skin, and the usual ecchymoses and evidences of contusion were remarkably absent. A more careful examination made at the patient's house, after a quarter of a grain of morphia had been administered hypodermically, clearly confirmed the diagnosis of simple fracture of the zygoma from direct injury, without other associated or complicating injuries.

This was gratifying, as the violence of the blow, coupled with the extreme pallor and other evidences of shock, had made me fear that the temporal shell might have been fissured and hæmorrhage from the meningeal media with all its consequences might take place. Fortunately, however, the force of the blow was broken by the zygomatic arch and by the thick temporal tendon which acted as a buffer beneath it. It was also evident by the acute pain felt whenever any attempt was made to open and close the mouth, and by the immobility of the depressed fragment, that the broken bone had been impacted below the temporal fascia in the subaponeurotic fat and connective tis-

sue, and probably into the temporal muscle itself. The diagnosis having been settled, the question of treatment now demanded consideration.

The pain, which was intense, was experienced by the patient with every motion of the lower jaw; the deformity, which was very striking, and the possibility of future ankylosis from rigidity of the temporalis in consequence of the depression by the displaced fragment, or by exudation, callous formation, etc., all demanded the replacement or reduction of the displaced bone as an immediate necessity. I had, therefore, decided, in harmony with the doctor's wishes, that I would cut down upon the impacted fragment with a view of raising it into its proper position by a hook or elevator, when the thought occurred to me that the reduction would be more easily effected and permanently maintained by the following and much more simple procedure:

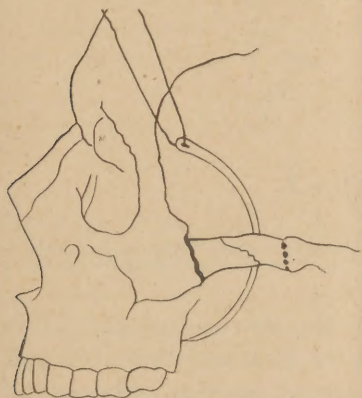


Fig. 1.

Curved needle carrying traction wire under fractured arch.

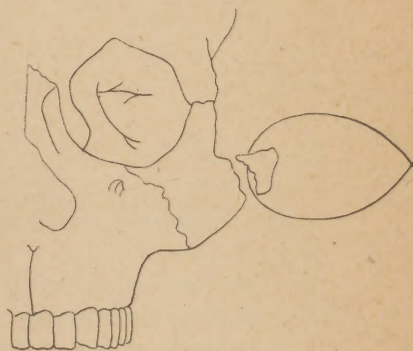


Fig. 2.

Wire *in situ*, ready for traction to replace displaced fragment.

OPERATION.—As the injured area was extremely sensitive a general anæsthetic was administered (chloroform) at the patient's request. The usual antiseptic precautions were carefully observed. A long, full curve (semi-circular) Hagedorn needle, threaded with silk as a carrier, was made to penetrate the skin about one inch above the midpoint of the displaced fragment and was carried well into the temporal fossa under the broken bone. (Fig. 1.) Then the point of the needle was raised and

made to emerge about half an inch below the lower border of the broken arch. As the needle was pulled out a strong silver wire about one foot long was attached to the silk carrier and dragged through the tract of the needle so as to form a metallic loop under the misplaced bone. (Fig. 2.) By twisting the ends of the wire together, a loop was formed which permitted strong and easy traction to be made on the broken fragment. With the index and middle fingers hooked under the wire loop,

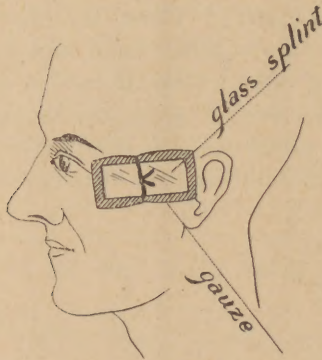


Fig. 3.

Fracture reduced; apposition maintained by a glass splint (microscopic slide) resting on a layer of iodoform gauze. The wire is twisted firmly over the glass slide.

traction was begun by pulling directly upward and outward. The moment this traction began the displaced fragment yielded and instantly returned to its normal position with a snap that was loud enough to be heard by the gentlemen who were assisting. The reduction was effected with all the suddenness and completeness that characterize the return of a displaced bone into its socket. The contour of the arch was immediately restored and the displaced fragment showed no disposition to relapse into its abnormal position. Notwithstanding the apparent permanency of the reduction I did not deem it prudent to trust the fracture without a more permanent support, and the following simple plan was then adopted to secure permanent fixation: An ordinary glass slide of the kind used for mounting microscopic sections, after careful sterilization, was wrapped in a layer of iodoform gauze and placed over the

seat of the fracture with its greatest length corresponding to the long axis of the zygoma. (Fig. 3.) The slide was long enough to rest upon the malar prominence anteriorly and upon the temporal root of the zygoma posteriorly, thus resting upon two fixed points. After twisting the wire firmly over it, it was evident that the bone could not be displaced, as the slide acted admirably as an external splint. The dressing was then completed by applying a layer of sterilized gauze and absorbent cotton over the slide as a dressing, the whole being held in place by a roller head bandage. The patient soon recovered from the anæsthetic and expressed himself as being relieved, especially of the peculiarly intense pain felt in moving the lower jaw.

On the second day following the reduction, a thin shell of vulcanite or dental rubber, moulded to the shape of the normal zygomatic prominence, was prepared by a dentist and substituted for the glass slide. The wire which held the fragment in position was not removed, but was simply twisted over the vulcanite shield without change or disturbance, after the removal of the glass slide. The new splint was now covered with a layer of absorbent cotton soaked in flexible collodion and applied without any additional dressing.

It is possible that the fracture would have remained reduced without the addition of the splint, but the possibility of return of the displacement by accidental causes during sleep, or mastication, obviously called for some means of permanent fixation, and as this was done so easily and effectually by the wire loop, it would have been imprudent not to have utilized it by leaving it *in situ*, for a week, as was done in this case.

The patient was confined to his room only twenty-four hours. On the second day he was able to attend a public meeting without suffering pain or serious inconvenience. On the ninth day the wire, splint and all dressings were permanently removed.

There has been ever since (about fifteen months ago), as the patient informs me, "a total absence of scar, deformity or inconvenience. Absolutely no impairment of function and no suffering."

REMARKS.

The relative prominence of the Zygomatic arch, sufficiently prominent, in fact, to give the face a marked physiognomic and ethnic character, would suggest, when associated with the great fragility and thinness of the temporal portion of this arch, that it would be liable to frequent fracture. That this is not the case and that it is indeed a very rare fracture is easily proven by consulting the literature of the subject.* Some idea of the comparative rarity of the injury, both as a simple and primary accident and as a complication of graver head injuries, may be obtained from the experience of Malgaigne.† He says, "this fracture is very rare. Duverney was the first to speak of it (1751). I have never myself met it. I have only been able to collect five cases: even these are not all free from doubt." Hamilton‡ refers only to three personal observations. Agnew§ refers to two cases and these he saw on the same day. My personal experience, in sixteen years of hospital work, is limited, with the present instance, to two cases. In the first case, the patient was seen in my service in the Charity Hospital over six years ago. The patient sought admission into the ward about one year after the injury. A simple depression existed in the mid-zygomatic region. The fracture had been caused by a blow with a base-ball bat. According to the patient's history a great deal of periorbital swelling and ecchymosis immediately followed the blow and so masked the zygomatic fracture that when the swelling cleared up it was too late to interfere. No treatment was therefore attempted and the patient gradually regained the power of mastication without pain. As the patient applied to us for the treatment of other conditions entirely independent of the zygomatic injury, no attention was paid to this, and no record was kept of this incident in his case. In

*The literature of the subject is not overburdened with references. Thus under the heading "Zygoma," in Volume XVI of the Index Catalogue of the Surgeon General's Library, issued in 1895, there are only eleven references to special papers on the subject of fractures of the arch. Since the issue of the Catalogue, the Index Medicus for 1895 and 1896, up to present date (July 28), only records two additional contributions on the subject. By consulting special monographs on Fractures we find that the whole bibliography of fractured zygoma (outside of the systematic texts) would probably sum up twenty-five *separate* reports or special articles, the majority of which have been consulted by the author and are referred to in the body of this article.

†Malgaigne: Fractures and Dislocations, American Edition, translated by Packard, Vol. i.

‡Hamilton: Fractures and Dislocations, 7th Edition, 1894.

§Agnew: Principles and Practice of Surgery, Vol. i, 1878.

this way it is also probable that some cases may have come under the observation of other hospital surgeons which do not appear on the records, because they were mere incidents in the past history of the patient without actual bearing upon the condition for which they sought admission into the hospital.

After my experience with the case of Dr. B., my curiosity was roused, and I decided to investigate the records of the hospital, with the view of determining the rate of prevalence of this fracture in hospital practice as accurately as the records would show. In undertaking this investigation I thoroughly appreciated the fact that only such cases would find their way into the records that were admitted to the hospital expressly for the treatment of this special injury. It is possible that some fractures of the zygoma were also admitted in which this fracture was a mere detail of a far more serious and extensive cranial injury. Such cases may have been classified simply as fracture of the skull without mention of details, but a close study of the hospital records has impressed me with the belief that these instances can not be many, and that fracture of the zygoma is just as rare a complication as it is a primitive injury. As a matter of fact, we find that only two fractures of the zygoma are recorded in seventeen years, from January, 1879, to January, 1896. One of these fractures came in in 1891; the patient a white man. The fracture was associated with a contusion of the scalp. The other occurred in 1894; in a male negro.*

The case of fractured zygoma in this year is classified under simple fractures (p. 72, report of 1895), but in the table of surgical operations a case is recorded as compound fracture with necrosis for which sequestrotomy was performed; presumably it is the same case.

In attempting to establish the rate of prevalence of zygomatic fracture on a basis of hospital experience, we must first determine the actual indoor population of this institution during the last seventeen years (1879-1896). This we find to be

*It is evident from this statement alone that the anatomical (racial) peculiarities of the zygoma in the negroes exercised no influence clinically upon the liability of this bone to fractures. It is well known that the prominence of this arch is greater in the negro. In all races the zygomatic process overlaps the malar bone at the line of union with the temporal, so as to assist it and the superior maxilla to resist the upward pressure to which they are subjected in mastication. The extent of this overlapping, as well as the strength of the zygomatic arch and the size of the space enclosed by it, are greater in the negro than in the European, and far greater in the Carnivora than in either. (Humphrey: *The Human Skeleton*, 1858.)

111,802 patients, exclusive of cases not diagnosticated. This morbid population included 3125 cases of fractures of all kinds; this being the sum total of fractures treated during the seventeen years. The prevalence of zygomatic fractures in the Charity Hospital of New Orleans could then be stated as follows:

Total number of cases, 2; (1 white, 1 colored).

Proportional prevalence to total fractures .064 per cent. (or 64 in 100,000, or nearly $6\frac{1}{2}$ in 10,000).

Proportional prevalence to hospital population .0018 per cent. (or 18 in 1,000,000, or nearly 2 in 100,000).

This summary surely confirms the statement that fracture of the zygoma is a very rare injury.

The results obtained by this inquiry into the frequency of the zygomatic fracture prompted a similar investigation of the malar bone, which constitutes a part of the arch, and is regionally exposed to the same causes that lead to the fractures of the zygoma but which, owing to the greater strength and solidity of its attachments to the skeleton of the face, is presumably more resistant to fracturing forces. We find, however, that statistically the rate of prevalence is very nearly the same. Thus in seventeen years there were three cases of fracture of the malar bone in the Charity Hospital. One case, a white patient, occurred in 1890; the other two cases, both negro patients, were admitted in the same year, 1886. The white case was complicated with fracture of the nasal bone, and the two negro cases were both compound and comminuted fractures.

The relative prevalence of malar fractures if stated on the same basis of population and total number of fractures previously given, in seventeen years, would be stated as follows:

Proportional prevalence to total number of fractures, .096 per cent. (or 96 in 100,000, or about $9\frac{1}{2}$ in 10,000).

Proportional prevalence to the hospital population, .0027 per cent. (or 27 in 1,000,000, or nearly 3 in 100,000).*

Fractures of the malar are, therefore, almost as rare as zygomatic fractures.

We should note that the fractures of the zygoma and malar

*These results now constitute a fragment of an extensive analytical study on the prevalence and mortality of individual fractures as they occur in the records of the Charity Hospital, in course of preparation by the writer, with the collaboration of Mr. E. Hynes, A. M. (Tulane).

here considered include all those that are mentioned in the records, so that, whether we consider them as primary injuries or as complications of graver accidents, these types of fracture are certainly rare.

MODE OF PRODUCTION.—It is obvious that the force that determines a fracture of the zygoma must usually be a direct one, and it is also plain, when we consider the anatomy of this part, that the break must usually take place on the temporal side of the temporo-malar suture, as this is its thinnest and narrowest part. The two cases that came under my observations were due to direct injury and the point of fracture was no exception to the general rule. Very rarely the arch may be broken by a force applied from within the mouth or by jamming back of the malar, in which case the fragment is displaced outward. The only published instances in which this has occurred are the cases which Duverney reported to the Anatomical Society of Paris (1810), that are referred to by the classics (Malgaigne, Hamilton, Packard and others). We are told that in one, a young child, having in its mouth the end of a lace bobbin, fell head foremost so that the end of the bobbin piercing the soft parts broke the zygomatic process from within outward.

Packard (Ashurst's Encyclopedia of Surgery, Vol. IV, p. 68,) refers to another case in which a fracture of the zygomatic arch had firmly united, with deformity outward. The injury had been caused by a blow on the face with a chain.

Hamilton and Agnew's experiments on the naked skull show that the zygoma may be broken and displaced in an outward direction by any force that will fracture the superior maxilla and depress the anterior margin of this malar bone. Fracture of the arch always takes place under these conditions at the same point, viz.: a little beyond the middle of the zygoma, in the temporal part of the suture, and close to it. The fractures experimentally produced were always transverse, and not in the line of the suture. Therefore, clinically and experimentally, we find that fractures of the zygoma almost exclusively take place in the temporal portion of the arch. So that this fracture may be virtually considered as a fracture of the temporal bone.

DIAGNOSIS.—The diagnosis of zygomatic fracture as a primary accident is usually of the simplest kind. A mere glance will reveal the deformity and will suffice to establish the diagnosis.

There are some cases in which there is fracture and yet no displacement. Tavignot's case, which was only discovered at a *post-mortem* examination, is an illustration of this occurrence. The fracture was caused by a fall during an epileptic fit. The skull was also fractured elsewhere, and the patient died on the fourth day. No one suspected that the zygoma was fractured. The possibility of fracture with a total absence of displacement is easily accounted for by the anatomy of the arch. The upper border of the arch gives a firm attachment to the strong temporal fascia which will not allow the fragment to be displaced unless it is torn away extensively on a level with the bone lesion. On the other hand, when the tear in the temporal fascia exists and there is no impaction of the broken piece, the tendency of the fragment is to downward displacement by the action of the masseter which is attached to the inferior border and internal surface. As the broken zygoma is displaced inward and downward it may be carried down as far as the sigmoid notch, where it may become locked with the coronoid process of the lower jaw, behind the attachment of the temporal tendon. Hence the pain and extreme difficulty in opening and closing the mouth which characterize the graver cases.

An excellent clinical picture of this condition in its most aggravated type is presented in the report by Dr. C. L. Bower:*

"M. F., aged 36, stepped on a long pole, which threw him down; the right side of his head struck the pole, producing a depressed fracture of the zygomatic arch. It caused considerable pain and swelling. On opening and shutting the mouth a kind of friction sound and rubbing sensation was noticed at the seat of the injury. This gradually increased until it was with difficulty that he could close his mouth. While chewing a piece of meat he suddenly found it impossible to close his mouth, which remained open, with the teeth of the two jaws about one inch apart. He could, by an effort, separate the jaws a little further, but was incapable of bringing them together. The deformity resembled a dislocation.

"It was at this time that I first saw him. On examination it was found that the zygoma was fractured a little posterior to the suture, and that the posterior fragment was greatly depressed, with either a decided bend, or perhaps another fracture further back near the tubercle.

"The coronoid process of the inferior maxilla was caught

* Polyclinic, Philadelphia, 1885-6, 111-137.

against the depressed fragment, which accounted for the fixation of the jaw.

"As it was impossible to reach the depressed fragment to elevate it, either externally or through the mouth, Dr. Levis made an incision of half an inch, just above the zygoma, then raised with an elevator, such as is used for elevating depressed fragments into position, which immediately allowed the jaw to close easily. I have not been able to follow the subsequent history of the case."

To determine the coexistence of other complicating lesions which affect the ultimate prognosis is not always so simple a matter. A zygomatic fracture may be only a minor detail in the striking picture presented by a case of fracture of the base, or fracture of the lateral surface of the cranium involving the middle meningeal artery or the cerebral contents. Dupuytren* and Tavignot (quoted by Hamilton, l. c.) report cases which illustrate these conditions, wherein graver injuries entirely mask or overshadow the lesser injury. These cases need not be considered here; they are extremely rare and are usually promptly fatal when they do occur. When met in practice, the treatment of the zygomatic fracture clearly sinks into relative insignificance and must be considered merely as a part of other and more important procedures.

A complication that is also extremely rare is an associated fracture of the zygoma with a fracture of the coronoid process of the lower jaw and a detachment of the insertion of the temporal tendon. Fracture of the coronoid process *alone* may be justly regarded as one of the curiosities of surgery. I do not know that any exists *without* other complications. Even the complicated cases are extremely rare. Thus far there appears to be but one case which has become classical, and that is Houzelot's patient, who, on falling from a height upon his chin, fractured both coronoid processes, both condyles and the symphysis of the lower jaw. Sir W. Fergusson (System of Practical Surgery, p. 457, Lond., 1870) refers to a similar case. The only recorded case that I am acquainted with, in which a fracture of the zygoma occurred simultaneously with a fracture of the coronoid, is mentioned by Park (Dennis, System of Surgery, 1896).

*Injuries and Diseases of Bone. Syd. Edit., Lond., 1847.

Though this combination of fractures must be difficult to produce, its occurrence is nevertheless easily understood, especially if the fracturing force is applied to the zygomatic region while the lower jaw is fixed firmly by the rigid contraction of the masseter and temporalis. Fortunately, also, a fracture of the coronoid process, even if transverse, will not be followed, in all probability, by the total detachment of the coronoid fragment, as the temporal tendon, which is so powerfully and broadly attached to the inner surface of the ramus of the lower maxilla, will prevent a marked displacement. A fracture of this process, should be readily recognized by intra-buccal exploration of the inner surface of the ramus with the finger. If such a fracture exists, absolute fixation of the lower jaw with a sling or permanent gutter dressing, with the view of securing rest and immobilizing the site of fracture, would probably be sufficient. The zygomatic fracture should be treated separately and by the means to be considered later.

When the zygomatic fracture is complicated with a fracture of the sphenoid in the zygomatic fossa, there may be a laceration of the mucous membrane of the corresponding nasal chamber with characteristic epistaxis. If the fracture involves the malar bone, the fissure may extend to the floor or walls of the orbit, and then marked subconjunctival ecchymosis, with some exophthalmos, will tell the tale. If anæsthesia of the cheek and corresponding half of the nose and upper lip exists, it will be reasonable to conclude that the fracture extends to the upper jaw and into the infra-orbital canal; if the gums and the teeth are also anæsthetized, the laceration or compression of the superior dental nerves is indicated.

The diagnostic value of these anæsthetized signs is shown in the case which Hifflesheim reported to the Société de Biologie de Paris, 1853.

In this case there was a direct fracture of the zygomatic arch associated with fracture into the intra-orbital foramen with compression of the infra-orbital nerve and partial anæsthesia of the face. These extensive radiating fractures involving the nerve canals are more characteristic of malar fractures. The more distinctive features of zygomatic fracture are the deformity and the painful interference with the functions of the tem-

poro-maxillary joint previously referred to and caused by impaction of the broken fragments in the temporal muscle, locking with the coronoid, or to the simple laceration of masseteric fibres. In any case, the symptoms are invariably relieved by the reduction of the displaced fragment.

TREATMENT.—Clinically speaking, all cases of fracture of the zygoma may be classed into the (*a*) simple, (*b*) compound, (*c*) complicated. Considering these in an inverse order, we would say that complications should be treated separately and in accordance with the special indications. The indications are based upon the usual principles that guide the surgeon in the treatment of all fractures, viz.: Reduction, fixation or immobilization and rest. If there are intracranial injuries, these should be attended to at first. If there is a fissure of the temporal shell or a depressed fracture of the skull, it should be met by direct incision, trephining and elevation. If there are symptoms of meningeal hæmorrhage, the meningeal trunk should be exposed by the recognized procedures, the clot removed and the artery controlled by plug or ligature. Coincident fractures of the upper jaw, the orbit, the malar, and of lower maxilla must be treated according to established methods which we can not stop to consider here—as we are now dealing only with zygomatic injuries.

In *compound fractures* of the zygomatic arch there is but one course to follow, and that is plainly to utilize the existing break in the soft parts with the view of replacing the displaced fragment, or removing any loose spiculæ if much comminution exists. If a compound fracture exists without much fragmentation the displaced bone can be reduced and fixed in the normal position by subcutaneous wiring, as was done in the case of our patient, Dr. B., here reported. The external wound can then be closed by suturing after thorough aseptic treatment and by using the aseptic glass splint and occlusive dressing, which will transform it into a simple fracture. The method of subcutaneous wiring and fixation with a wire loop over a glass splint is not only simple and reliable but is more benign in its consequences than the method of elevating by means of a screw or of drilling capillary holes into the loose fragment and wiring it to the remaining portion of the arch. Drilling holes into so delicate a lamina of bone as the posterior half of the zygomatic

arch is liable to lead to further fragmentation of the detached bone and cause additional and unnecessary traumatism. Furthermore, the presence of the wire, catgut or other *buried* suture material used to hold the fragments together, is not advantageous or desirable when the same results can be obtained without them. Hence, I believe that even in compound fractures of the zygoma, the method applied in the case herein reported is to be preferred to the usual and less satisfactory procedures advised in the text.

Simple Fractures.—While all writers are as a unit in recommending immediate reduction and fixation by direct interference in all cases of *open* compound fractures, they are much more conservative and guarded in their advice in dealing with simple fractures. This tendency to non-interference in simple fractures has been justified by the belief that in many cases of marked fractures and displacement and deformity the functional disturbances connected with mastication were finally overcome, with little if any assistance, by the efforts of nature alone, as is demonstrated by Hamilton's* and Agnew's† experience, as well as by the cases reported by Bellamy‡, Clark§, Garland§, Prewitt and others. It is also recognized that the ordinary course of the uncomplicated fractures is toward a benign and favorable termination, the tendency being toward a gradual accommodation of the parts with rapid repair and slight callus formation.

We note, therefore, that all authorities, even to the latest, advise interference conditionally. They all concur with the views expressed by Malgaigne, and subsequently by Hamilton and his followers, to the present generation, to the effect that it is seldom possible to reduce the displacement completely because it is generally inwards, and there is no way of acting efficiently on the bone except through a wound in the skin. (Stimson, *Fractures*, loc. cit.).

This conditional recommendation to interfere by open section is thus stated by Dean (*Tréves' System of Surgery*, Vol. 11 1896): "In the case of a fracture with depression of the zygo-

*Loc. cit.

†Loc. cit.

‡Bellamy: "Fracture of the Zygoma" (*Lancet*, London, 1872, 1, 186).

§Clark (F. L. G.): (St. Thomas Hospital Report, London, 1887, ns. XVII, 3).

§Garland (O. H.): "Impacted Fracture of the Zygoma," *Lancet*, London, 1885, 11, 1185.

*Prewitt (T. F.): "Fracture of the Zygoma," *St. Louis Courier of Medicine*, 1886, XVI, 126).

matic arch no treatment is necessary if the lower jaw can be used without any trouble. But, if the movements of the lower jaw are interfered with, an incision should be made and the depressed fragment must be elevated and kept in position by wiring if necessary."

Park, in his excellent article in Dennis' System of Surgery (Vol. II, p. 765, 1896), expresses himself more broadly: "These cases will not permit of complete reduction of fragments unless there be a wound of the skin. Should it appear that serious disadvantage results from this condition, it would be perfectly justifiable to make an opening under aseptic precautions, and with suitable instruments draw the displaced arch into position, securing it there, if necessary, either by drilling or wiring, or by temporarily fastening the bone with silver wire to some external support."

It is evident that these recommendations to interfere are made conditional, partly, because of the slight importance attached to this fracture, and partly because of the acknowledged difficulty of reduction without complicating the original injury by an open section. Nevertheless, the fact that in distinctly recognizable fractures of the arch there is deformity and very considerable if not unbearable pain during mastication, which is likely to continue for days, weeks, and even months; also, that the final consequences of this fracture can not be foretold, often, until the opportunity for simple reduction and repair is past; and, furthermore, that permanent impairment of the function of mastication may follow this injury* would suggest the advisability of immediate reduction in every case in which there is evidence of fracture with displacement and deformity regardless of other more pronounced indications. The wisdom of this course is emphasized when we consider that the pain, general distress and deformity which characterize this injury can be instantly relieved by the simple reduction of the fracture.

The possible risk of infection, though largely disregarded by the contemporary surgeon, is still considered in the writings of

* Case quoted by Muhlenberg; *Philadelphia Medical Times*, May 15, 1871. Stimson has briefly described a case in which the displacement seriously interfered with the movements of the jaw. The difficulty steadily increased until the patient could barely separate the teeth. Then one morning while yawning he felt something snap, and the motion of the jaw became and remained free.

the day, though not as much as when Malgaigne defended Ferrier's first reduction of this fracture by the open method* in 1859. Dupuytren, who had been "horrified" by reading the account of Ferrier's first operation, only reflected the conditions of surgery of his period. Dupuytren himself had once used the elevator in restoring a fractured arch, but it was through a wound which complicated the fracture. Inflammation ensued, pus formed and infiltrated its way along the coronoid and opened into the mouth. However, the patient recovered in six weeks. This experience, which was typical of the period, was calculated to make surgeons cautious in following Ferrier's example, even in the modern period. If we bear in mind, that in all direct fractures, the skin and soft parts at the point of injury are badly damaged by the direct blow which has caused the fracture, we can readily understand that a slight flaw in the asepsis is likely to be followed by infection of the sub-aponeurotic connective tissue of the zygomatic fossa, which may lead to purulent infiltration and final necrosis of the broken fragment or cicatricial ankylosis of the lower jaw. While all these fears are almost groundless and have no reason to be in the mind of the aseptic operator, they are nevertheless possibilities in general practice that can not be disregarded; hence, the simple and ready methods that can be applied safely by all practitioners are still in demand. Unfortunately, the procedures hitherto described, which aim at reduction without cutting or penetrating the tissues, are not reliable. For instance, Duverney (1751) claimed that he had succeeded in forcing the displaced arch into position by the pressure of the finger in the mouth. That reduction by this method is impracticable was demonstrated long ago by Malgaigne, and any one who will try to reach the zygoma by this route will soon convince himself of its fallacy. The difficulties in the way of success by this method are well exhibited in the following case reported by Bellamy (*Lancet*, London, 1872, 1, 186):

"A. B., aged 40, a man of unhealthy hydrocephalic aspect, applied at the hospital in January, 1872, with a severe bruise (the result of a blow with the fist) of the left side of the face; inability to open the jaw beyond a certain distance, and with what he described as a tooth sticking into his cheek.

*Ferrier (of Arles), *Bulletin des Sciences Médicales*, tom. X, p. 100.

He said he could feel nothing on the left side of his cheek and gum, and that it was 'all cold like.'

"Examination evidently showed fracture of the zygoma, and most probably fracture of the zygomatic process of the temporal bone, with disarticulation of it from the malar, the dislocated end being forced down toward the cavity of the mouth, having apparently the buccinator and buccal mucous membrane only between its rough extremity and the finger.

"An attempt was made at reduction by passing the finger into the buccal cavity and pushing the end of the bone upward and inward, but the pain was excessive. Moreover, even when something like approximation was attained, directly the masseter was put into action, the fragment assumed its former position. The nervous symptoms seemed to point to pressure and implication of the middle and lower division of the fifth and its inosculation. He appeared to be, moreover, unable to inflate the side of the cheek corresponding to the accident, there being apparently pressure upon the buccal nerve of the lower division of the fifth. There appeared very slight deformity.

"On his next visit (January 5) there was less pain, and he could open the jaw slightly, the other symptoms remaining much the same."

Duverney also reported a case in which reduction of a simple fracture was impossible by intrabuccal digital compression. He then resorted to an expedient which was more successful. He introduced a small block of wood between the last molars of the jaw. The patient was then ordered to bite as hard as possible on the wedge. This led to a contraction of the temporal with rigidity of the tendon. The coronoid process being partially extended and fixed by the contraction of the jaw, the displaced zygomatic fragment was forced into position by the contracting temporalis.

This is very pretty theoretically, but it is not practicable in the majority of cases, as the pain caused by any contraction of the muscles of mastication is unbearable.

Very recently, P. di Capraris, of Naples, reports a successful reduction of this fracture (Incurabili, Napoli, 1896, XI, 41-46) in a male, adult, æt. 40, whose zygoma was broken at the mid-point by the impact of a stone hurled at him in an altercation. The patient was partially stunned by the blow, but recovered promptly and started in pursuit of his adversary. Failing in his search, he returned home, when he noticed that he could not open his mouth, and that when he tried to force open his mouth he ex-

perienced a most acute pain in the region of the temporo-maxillary articulation. He also noticed a tingling, formication and anæsthesia in the left cheek, evidently from injury to the malar fibres of the fifth pair, and probably from compression of the buccal branches of the same nerve. The patient consulted Di Capraris, who recognized the zygomatic nature of the fracture.

An attempt at reduction was made by Duverney's procedure, with the finger in the mouth, but, failing in this, he decided to pry it by leverage into position through the mouth. For this purpose he availed himself of the handle of Daviel's wooden rectal scoop for the relief of fecal impaction. The handle, which is flat on one side and convex on the other, was wrapped in gauze, and was introduced under the cheek, close to the upper jaw, near the last upper molar. The lever was then forced upward and forward toward the arch. After the third effort he had the satisfaction of prying the fragment into position, and all the symptoms and pain experienced by the patient disappeared as if by enchantment. The patient opened his mouth widely, the anæsthesia, the pain and the deformity disappeared. Di Capraris saw the patient two years afterward, and he appeared to be entirely well, with no perceptible disfigurement. No efforts were made to maintain fixation of the broken fragments after reduction.

Di Capraris appears to be well satisfied with his procedure, and it is so simple that is worthy of trial in any uncomplicated case, at least as a preliminary measure. Should it fail in effecting the reduction, or should a redisplacement follow with further movements of the jaw, then the next method of election would be the procedure that I have described in relating my personal experience. This method, which I would designate as the method of subcutaneous reduction and fixation by wiring, is in every sense simple and practical in its application. In the majority of the cases, I believe, it can be applied without a general anæsthetic—cocain anæsthesia by Schleich's infiltration method being sufficient. It is certain to accomplish its purpose, and has the decided advantage of leaving no noticeable scar.

Stromeyer (quoted by Albert and Di Capraris) also suggested a procedure which consists in hooking the displaced fragment with a long tenaculum introduced through the skin. This may succeed in some cases, but like all the bloodless

methods that have been described, does not provide against relapse or secondary displacement, and in this way is inferior to the simple procedure that I have practised and described, I believe, for the first time.

